MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2015/2016

EME2036 – MANUFACTURING AND OPERATIONS MANAGEMENT

(ME, RE)

3 JUNE 2016
3.00 p.m - 5.00 p.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of **8** pages with **4** Questions and Appendices only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the answer booklet provided.

Question 1

(a) The **Table Q1 (a)** provides information about a shipping company's project activity. The indirect cost for the project is RM100 per day. The company will incur a penalty of RM100 each day if the project lasts beyond 14 days.

Table Q1 (a) Shipping Company's project activity information

Activity	Normal Time (days)	Normal Cost (RM)	Crash Time (days)	Crash Cost (RM)	Immediate Predecessors(s)
A	5	900	4	1,100	-
B	5	700	3	1,900	-
C	2	500	1	800	A, B
D	3	1,200	2	1,700	B
E	5	900	3	1,200	C, D
F	2	1,300	1	1,400	E
G	3	900	3	900	E
H	5	500	3	900	G

i. Draw an activity on node networking diagram and calculate the project's duration and costs if only normal times are used? **[5 marks]**

ii. Calculate the total project cost by crashing activities E and H for 2 days each. **[8 marks]**

iii. What is the new critical path and duration after crashing activity? **[2 marks]**

b) YTM Portland cement produces calcium hydroxide and carbonation for concrete industry. Both product were blended in large mixers and then stored into big containers. The management is concerned about whether stored quantity of the mix is in statistical control. The process should be centered on eight hundred kilograms per container. Several samples of eight containers were taken, each container was checked, and the data is given in **Table Q1 (b)**.

i. Assume eight observations and develop the control charts for the mean and range

[6 Marks]

ii. Plot the observations on the control chart and comment on your findings.

[4 Marks]

Continued .....

Table Q1 (b)

Sample No.	Observation of container weight (in kg)							
	1	2	3	4	5	6	7	8
1	798	834	802	794	844	768	781	811
2	833	822	808	851	841	828	809	816
3	789	777	791	804	800	789	793	809
4	824	818	783	8.05	790	816	797	807
5	787	813	792	799	810	781	814	788
6	813	814	811	813	814	812	813	814

Question 2

(a) An automatic car wash center with a single bay has an average service rate of 10 cars per hour, according to an exponential distribution. On a typical Saturday morning, cars arrive at a mean rate of 8 per hour, with arrivals tending to follow a Poisson distribution.

i. Determine the probability of 10 cars in line. **[5 marks]**

ii. Determine the average number of cars in the waiting line. **[5 marks]**

iii. Determine the average waiting time (in hour) of cars in line. **[5 marks]**

b) FET Manufacturing is investigating which location would best position its new plant relative to two suppliers and one market area (Klang, Kuantan and KL). Management limited the search for this plant to those tree locations and complied the following **Table Q2 (b)**:

Table Q2 (b)

Location	Coordinates (km)	Tons per Year	Freight Rate (RM/ton-km)
KL	(100,200)	4,000	RM30
Kuantan	(400,100)	3,000	RM10
Klang	(100,100)	4,000	RM30

i. Which of the three locations gives the lowest total cost, based on Euclidean distances? **[5 marks]**

ii. Which location is best, based on rectilinear distances? **[5 marks]**

Continued .....

Question 3

(a) Siva runs a mail-order business for bicycle equipment. Annual demand for the Suspension Fork is 15,000. The annual holding cost per unit is RM 2.70 and the cost to place an order is RM 65. What is the economic order quantity?

[3 Marks]

(b) Siva orders 2,500 bicycle brake cable a year. Brake cables are priced from supplier as given in **Table Q3 (b)**. 1 to 499, 90 cents each; 500 to 999, 85 cents each; and 1,000 or more, 80 cents each. It costs approximately RM 27 to prepare an order and receive it, and carrying costs are 40 percent of purchase price per unit on an annual basis. Determine the optimal order quantity and the total annual cost.

Table Q 3 (b)

Range	Unit Price	H
1 to 499	RM 0.90	RM 0.36
500 to 999	RM 0.85	RM 0.34
1,000 or more	RM 0.80	RM 0.32

[12 Marks]

c) The **Table Q3 (c)** below shows the demand for a particular brand of notebook in a shop for each of the last nine months.

Table Q3 (c)

Month	1	2	3	4	5	6	7	8	9
Demand	10	12	13	17	15	20	20	21	20

i. Calculate a three month moving average for months three to nine. What would be your forecast for the demand in month ten?

[4 marks]

ii. Apply exponential smoothing with a smoothing constant of 0.3 to derive a forecast for the demand in month ten.

[4 marks]

iii. Which of the two forecasts for month ten do you prefer and why?

[2 marks]

Continued .....

Question 4

(a) **Figure Q4 (a)** illustrates the bill of material for product A. The master production schedule start row in the master production schedule for product A calls for 50 units in week 2, 65 units in week 5 and 80 units in week 8. Item C is produced to make product A and to meet the forecasted demand for replacement parts. Past replacement part demand has been 20 units per week (add to C's gross requirements). The lead times for items F and C are 1 week, and for the other items the lead time is 2 weeks. No safety stock is required for items B, C, D, E and F. The L4L lot-sizing rule is used for items B and F; the POQ lot-sizing rule (p=3) is used for C. Items E has an FOQ of 600 units and D has an FOQ of 250 units. On-hand inventories are 50 units of B, 50 units of C, 120 units of D, 70 units of E and 250 units of F. Item B has a scheduled receipt of 50 units in week 2. Develop a material requirements plan for the next 8 weeks for items C and F. The material requirements plan for item B is given in **Table Q4 (a)**.

[10 marks]

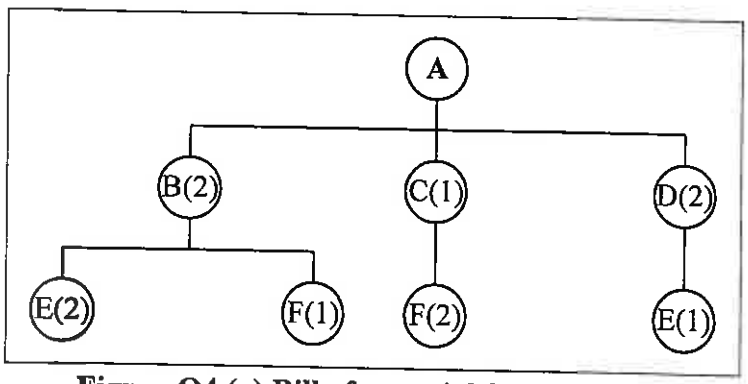

Figure Q4 (a) Bill of material for product A

Table Q4 (a)

Item: B						**Lot Size:**		**L4L**	
Description:						**Lead Time:**		**2 weeks**	
Week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross requirements		100			130			160
Scheduled receipts		50						
Projected on hand 50	50	0	0	0	0	0	0	0
Planned receipts					130			160
Planned order releases			130			160		

Continued .....

(b) Bradley and Alexander are two well established suppliers of inexpensive tools. Weekend Projects is a national chain of retail outlets that caters to the occasional fixer-upper who would prefer to get the job done fast rather that investing in a well-appointed tool box. Weekend Projects wants to find a supplier for a particular tool set that promises to be a big seller. Expected annual sales are 100,000 units. Weekend's warehouses operate 50 weeks a year. Management collected data on the two suppliers, which are contained in the **Table Q4 (b)**.

Which of the two suppliers would provide the lowest annual cost to Weekend Project? What shipping quantity would you suggest? **[10 marks]**

Table Q4 (b)

Supplier	Freight Costs Shipping Quantity			Price/ Unit	Annual Holding Cost/ Unit	Lead Time (wks)	Annual Administrative Cost
	10,000	25,000	50,000				
Bradley	$35,000	$25,000	$18,000	$8.10	$1.62	6	$10,000
Alexander	$40,000	$28,000	$19,000	$8.10	$1.62	4	$15,000

(c) The spot welding is a bottleneck operation in the production of Autocar Sdn. Bhd. Four jobs are waiting to be processed. The available operation data are shown in **Table Q4 (c).** Assume that the current date is week 7 and that the number of remaining operations and the shop time remaining include the operation at the spot welding.

Table Q4 (c)

Job	Processing Time (Weeks)	Due Date (Weeks)	Number of Operations Remaining	Shop Time Remaining (Weeks)
A	8	20	6	5
B	16	32	8	7
C	26	42	20	10
D	12	46	6	13

Specify the priority for each job by using slack per remaining operations (S/RO) rule. **[5 marks]**

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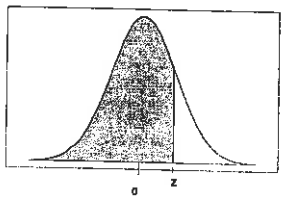
Appendix I

Standard Normal Cumulative Probability Table



Cumulative probabilities for POSITIVE z-values are in the following table:

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990

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Appendix Table 1 Factors for calculating three-sigma limits for the x-chart and R-chart

Size of Sample (n)	Factor for UCL and LCL for x-Chart (A_2)	Factor for LCL for R-Chart (D_3)	Factor for UCL for R-Chart (D_4)
2	1.880	0	3.267
3	1.023	0	2.575
4	0.729	0	2.282
5	0.577	0	2.115
6	0.483	0	2.004
7	0.419	0.076	1.924
8	0.373	0.136	1.864
9	0.337	0.184	1.816
10	0.308	0.223	1.777

Process capability:

$$C_{pk} = Minimum\ of \left[\frac{\bar{\bar{x}} - Lower\ specification}{3\sigma}; \frac{Upper\ specification - \bar{\bar{x}}}{3\sigma}\right]$$

$$C_P = \left[\frac{Upper\ specification - Lower\ specificaation}{6\sigma}\right]$$

Waiting Line Models Equations:

$$P_n = (1-\rho)\rho^n \qquad P_n = \begin{cases} \dfrac{(\lambda/\mu)^n}{n!}P_0 & 0 < n < s \\ \dfrac{(\lambda/\mu)^n}{s!s^{n-s}}P_0 & n \geq s \end{cases}$$

$$P_0 = (1-\rho) \qquad P_0 = \left[\sum_{n=0}^{s-1}\frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^s}{s!}\left(\frac{1}{1-\rho}\right)\right]^{-1} \qquad P_0 = \left[\sum_{n=0}^{N}\frac{N!}{(N-n)!}\left(\frac{\lambda}{\mu}\right)^n\right]^{-1}$$

$$L = \frac{\lambda}{\mu-\lambda} \qquad L = \lambda W \qquad L = N - \frac{\lambda+\mu}{\lambda}(1-P_0)$$

$$L_q = \rho L \qquad L_q = \frac{P_0(\lambda/\mu)^s\rho}{s!(1-\rho)^2} \qquad L_q = N - \frac{\lambda+\mu}{\lambda}(1-P_0)$$

$$W = \frac{1}{\mu-\lambda} \qquad W = W_q + \frac{1}{\mu} \qquad W = L[(N-L)\lambda]^{-1}$$

$$W_q = \rho W \qquad W_q = \frac{L_q}{\lambda} \qquad W_q = L_q[(N-L)\lambda]^{-1}$$

End of paper